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WHAT IS CLAIMED IS:

1. A method of cleaning a dual damascene structure, comprising:

providing a substrate, wherein a first metal layer, a cap layer, and a dielectric layer are formed in sequence on the substrate;

forming a dual damascene opening in the dielectric layer and the cap layer to expose the first metal layer;

performing a post-etching cleaning step to clean the dual damascene opening using a fluorine-based organic solvent; and

sputtering an argon gas to clean the dual damascene opening before forming a second metal layer in the dual damascene opening.

2. The method of claim 1, wherein the fluorine-based organic solvent includes an organic solvent with fluoride acetate acid as a principal solvent.

3. The method of claim 2, wherein the fluorine-based organic solvent has a chelating agent and an oxidizing agent.

- 4. The method of claim 1, wherein the fluorine-based organic solvent includes an organic solvent with ammonium fluoride as a principal solvent.
- 5. The method of claim 4, wherein the fluorine-based organic solvent has a chelating agent and an oxidizing agent.
- 6. The method of claim 1, wherein a sputtering power is between 75 and 300 watts to sputter the argon gas in the dual damascene opening.
- 7. The method of claim 1, wherein a sputtering time is about 10 to 30 seconds to sputter the argon gas in the dual damascene opening.
- 8. The method of claim 1, wherein the material of the cap layer is silicon nitride (SiN).

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- 9. The method of claim 1, wherein the material of dielectric layer has a low dielectric constant (low-k), and is silicate based or an organic material.
 - 10. A method of cleaning a dual damascene structure, comprising:

providing a substrate, wherein a first metal layer, a cap layer, and a dielectric layer are formed in sequence on the substrate;

forming a dual damascene opening in the dielectric layer and the cap layer to expose the first metal layer;

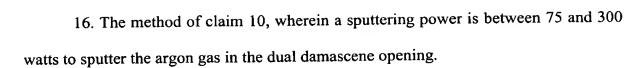
performing a <u>first post-etching</u> cleaning step to clean the dual damascene opening using an oxidizing agent based solvent;

performing a second post-etching cleaning step to clean the dual damascene opening using a hydrofluoric acid solvent; and

sputtering an argon gas to clean the dual damascene opening before forming a second metal layer in the dual damascene opening.

- 11. The method of claim 10, wherein the oxidizing agent based solvent has a hydrogen peroxide (H2O2) based solvent.
- 12. The method of claim 11, wherein the hydrogen peroxide based solvent is a mixture of hydrogen peroxide and water at a ratio of between 1:24 and 1:80.
- 13. The method of claim 11, wherein a stable temperature controls the reaction of the hydrogen peroxide solvent and prevents over oxidizing on the first metal layer.
- 14. The method of claim 13, wherein the temperature is between 40 and 60 Celsius.
- 15. The method of claim 10, wherein the hydrofluoric acid solvent is a mixture of hydrofluoric acid and water at a ratio of 1:600.

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- 17. The method of claim 10, wherein a time of sputtering the argon gas in the dual damascene opening is between about 10 and 30 seconds.
- 18. The method of claim 10, wherein a material of the cap layer is silicon nitride (SiN).
- 19. The method of claim 10, wherein the material of the dielectric layer has a low dielectric constant (low-k), and is silicate based or fluorine carbide.
 - 20. The method of claim 10, wherein a material of the first metal layer is copper.